

TEACHER EVENT CHECKLIST

SPACE FARMING EXPEDITION (Plant Growth in Space)

Date Completed	PRE EVENT REQUIREMENTS
	1. Print out a copy of this entire file (color copy preferred). Please note: this document is 15 pages long.
	2. Sign Agreement to Participate on page 2 and E-mail it to Distance Learning Outpost within 3 business days of confirmation.
	3. Have students take Pre-Event Quiz on page 5.
	4. Complete all pre-event activities on page 4 with the students.
	5. Teacher to E-mail a minimum of 5 student questions to our office no later than 3 business days prior to your event.
	6. Review NASA Event Guidelines on page 8 with students.
	DAY OF EVENT ACTIVITIES
	1. The students will be asked to share their results from their pre-work activities with the NASA DLO presenter.
	POST EVENT REQUIREMENTS
	1. Have students take Post-Event Quiz on page 5 for evaluation and assessment.
	2. Teacher(s) and students to fill out event feedback on page 9.
	2. Distance Learning Outpost will respond to any follow-up questions.
	3. At teacher's discretion, students can complete extended activities on page 9.

Teacher Agreement To Participate
NASA's Distance Learning Outpost

I have reviewed the Space Farming Learning Module and agree to complete all of the required activities with my students, both prior to, and following, the video teleconferencing event. I also agree to fill out the feedback form at the conclusion of the event.

Teacher(s) _____

School/Institution _____

Event # _____

Date of Event _____

Fax this form to the Distance Learning Outpost Office at (281) 483-3789

or

E-mail to dlo1@jsc.nasa.gov within 3 business days of confirmation.

**NASA's Distance Learning Outpost
Space Farming (Grades K-4)**

Instructional Goal

Upon completion of this learning module, students will be able to explain why space farming is crucial to long-term expeditions in space and how it can be achieved.

Learning Objectives

1. Students will be able to list several requirements for plants to grow.
2. Students will be able to explain how the requirements for plant growth can be met off of Earth.
3. Students will be able to discuss why space farming is necessary for long-term space missions.

National Education Standards

Science Standards (NSTA)

Abilities to Do Scientific Inquiry

Understanding about scientific Inquiry

Life Science

Structure and Function in Living Systems

Mathematics Standards

Understand numbers

Ways of representing numbers, relationships among numbers, and number systems

Texas Essential Knowledge and Skills (TEKS)

Science

K.9A
1.7D
1.9
2.9
3.5A
3.8
3.11B
4.10A
4.11C



Grade Level:

Grades K-4

Estimated Time Requirements:

1. Preparation Time
 - a. Time necessary to download & print the lesson from the computer
 - b. Time necessary to become familiar with the lesson
2. Execution Time by Activity
 - a. Activity Set #1 30 minutes
 - b. Activity Set #2 (choose one)
 - i. Activity A 4 weeks
 - ii. Activity B 1+ week
 - iii. Activity C 1 week
 - c. Activity Set #3 25 minutes
 - d. Video Teleconference 50 minutes

STUDENTS WILL BE ASKED TO SHARE THEIR RESULTS DURING THE VIDEO TELECONFERENCE WITH NASA.

INSTRUCTIONAL STRATEGY

Overview

Plants are an important component for space-based and extraterrestrial life support systems. Just as they do on Earth, plants in a regenerative life support system can take carbon dioxide from the atmosphere and produce breathable oxygen through a process called photosynthesis. Of course, plants are also a source of food. So, in theory, plants could provide two essential elements needed for humans to live in space: oxygen to breathe and food to eat. Before plants can deliver these essentials, however, NASA must learn how to grow plants in space, and how to incorporate them and other biological components into life support system research facilities, here on Earth.

Pre-Event Classroom Component

Activity Set #1

1. Students take the [Pre-Event Quiz](#) on page 5 to test their knowledge prior to lessons about Space Farming. Students keep these quizzes on file to compare to their [Post-Event Quiz](#) for evaluation and assessment.
2. Students should become familiar with the [terminology](#) on page 7 that will be used in the activities and during the event with NASA. It is up to the teacher's discretion on how and when to introduce the terms.

Activity Set #2

Please select at one, ideally all 3, of the activities below (A-B) to complete with your class.

1. [Will It Grow?](#) at http://www.nasaexplores.com/show2_k_4a.php?id=03-014&gl=k4

In this activity, students will compare and contrast plant growth in a variety of mediums. **Students will be asked to share their bar graphs and results during the video teleconference.**

2. [Space Spuds](#) at http://www.nasaexplores.com/show2_k_4a.php?id=03-014&gl=k4

In this activity, students will grow grass seeds using potatoes. **Students will be asked to share why the grass grew out of the potato in a glass of water.**

3. [Lights Out](#) at http://www.nasaexplores.com/show2_k_4a.php?id=03-014&gl=k4

In this activity, students will determine the effects of light on plants and skin color. **Students will be asked to share their graph during the video teleconference.**

Activity Set #3

1. Student Questions
 - Develop at least 5 questions from the class on Space Farming
 - These questions should go beyond the basic information within the program
 - These questions should attempt to demonstrate "higher cognitive involvement" by the students
 - E-mail your questions at least 3 business days prior to your event with NASA
 - E-mail address is: DLO1@jsc.nasa.gov
2. Prepare students for their participation in a live, interactive video teleconference with NASA's Distance Learning Outpost using the [guide](#) on page 8.

1. What do plants require to grow on Earth?
2. Which of the requirements you decided on in #1 are also *naturally* provided off of Earth?
3. For each of the requirements you came up with in #1 that does *not* naturally occur off of Earth, explain how we might supply it.
4. Why is it important that we know how to grow healthy plants off of Earth?

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Pre/Post Quiz
Space Farming Expedition

TEACHER ANSWER KEY – Please don't share with the students. Answers should be similar to:

1. What do plants require to grow on Earth?

Plants need the correct temperature, carbon dioxide, light, nutrients, and water.

2. Which of the requirements you decided on in #1 are also *naturally* provided off of Earth?

None are.

3. For each of the requirements you came up with for plant growth that does *not* naturally occur off of Earth, explain how we might supply it.

Accept any answer that makes sense. There is not one answer to this question because there are many ways to supply each requirement; it is just that some are more efficient than others.

4. Why is it important that we know how to grow healthy plants off of Earth?

Currently we cannot do long-term space missions because we are dependent on Earth to supply us with our supplies. If we are ever to send humans to Mars or to the moon for more than a few days, the crew needs to be independent of Earth and grow their own plants. Plants not only provide food and oxygen, they also recycle wastewater and create an aesthetically pleasing and emotionally comforting atmosphere for the astronauts.

Space Farming Terminology

The following is a list of words and definitions that your students need to be familiar with because the words are used throughout the activities and video teleconference. They will be asked to explain the meaning of these terms **in their own words** during the teleconference.

<u>Hydroponics</u>	The growing of plants in nutrient solutions with or without an inert medium to provide mechanical support
<u>Photosynthesis</u>	The process by which a plant uses the energy from the light of the sun to produce its own food using chlorophyll water + carbon dioxide in the presence of light = sugar + oxygen
<u>Gravitropism</u>	The response of plants to the pull of gravity, including the tendency for plant roots to grow downward in the direction of gravity and plant shoots to grow upward against gravity
<u>Hydrotropism</u>	The growth of an organism or a part, such as a root, in response to the presence of water
<u>Phototropism</u>	Growth or movement toward or away from a light source
<u>Macronutrients</u>	Nutrients required in the greatest amount (e.g., carbohydrates, protein, fats.)
<u>Micronutrients</u>	Substances needed only in small amounts for normal function (e.g., vitamins or minerals)
<u>Microgravity</u>	Freefall causes reduced gravity, NOT zero gravity. There is still gravity it is just very weak.

The thirteen essential minerals for plants include nitrogen (N), potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), sulphur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), molybdenum (Mo), boron (B), and chlorine (Cl).

Background Article to Help You Become Familiar with Space Farming

1. Plants In Space http://nasaexplores.com/search_nav_5_8.php?id=01-048&gl=58

NASA Event Guidelines

Review the following points with your students prior to the video teleconference event:

1. A video teleconference is a two-way event. Students and NASA presenters can see and hear one another.
2. Students are representing their school; they should be on their best behavior.
3. Students should be prepared to give brief presentations, ask questions and respond to the NASA presenters.
4. A Teacher(s) or other site facilitator should moderate students' questions and answers.
5. Students should speak into the microphone in a loud, clear voice.

**Get Ready, Be Ready, and have fun with your
Distance Learning Event with NASA!**

Post Event Teacher – Student Evaluation

1. **We need your help and support!** Choose the appropriate Form below. It usually takes teachers and students **less than 10 minutes** to complete. We welcome any input that you have at the following sites:
 1. Teacher Feedback Form:
https://ehb2.gsfc.nasa.gov/edcats/centers/distance_learning.html
 2. Student K-4 Feedback Form:
[TBD](#)
 3. Student 5-8 Feedback Form:
[TBD](#)
 4. Student 9-12 Feedback Form:
[TBD](#)
 5. Technical Contact Feedback Form:
https://ehb2.gsfc.nasa.gov/edcats/centers/jsc_dlo_tech_contact.html
 6. Parent/Chaperone Feedback Form:
https://ehb2.gsfc.nasa.gov/edcats/centers/distance_learning_parent.html
2. Students and Teachers are **welcome to e-mail the Distance Learning Outpost** with any follow-up questions from the event at: <mailto:DLO1@jsc.nasa.gov>
3. **Please send** us any photos, video, web page link, newspapers articles, etc. of your event. We will be glad to post them on our web page!

Extended Activities for Space Farming

1. Perform further research on the Internet at:
<http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Space.Food.and.Nutrition/Space.Food.and.Nutrition.pdf>
or
<http://www.nasa.gov/>